Velocity and Acceleration Lab Investigation

Essential Question: Can you determine the acceleration of a ball as it travels? How is does the velocity of the marble affect its acceleration?

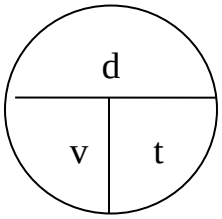
Hypothesis:

Will a ball continually accelerate as it travels a distance of 3m? Or will it decelerate? Explain your answer.

_____

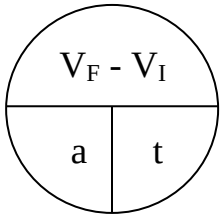
Research:

- *Velocity* is the distance an object travels per unit of time in a certain direction. Velocity can be expressed as kilometers per hour (km/hr), meters per second (m/s), etc. In most cases, objects don't travel at a constant velocity. Therefore, the average velocity is used to describe the motion.



v = velocity, t = time, and d = distance

- *Acceleration* is the rate at which an object's speed changes. Acceleration can be expressed as meters per second per second (m/s/s or m/s^2). Forces such as gravity, air resistance, and friction can cause an object to decelerate (decrease speed over time). Other forces can cause and object to accelerate (increase speed over time). If the car does not encounter these forces and travels at a constant speed, then it is not changing speed and there is no acceleration or deceleration.



a = acceleration, V_f = final velocity, V_I = initial velocity, and t = time

Experiment:

Materials- stack of books, ramp, masking tape, stopwatch, meter stick, pen or pencil, and ball

Procedure-

1. Set up a 3m runway with a ramp at one end that raises 3 books high.
2. Place a masking tape marker where the ramp touches the floor and label 0m. Label also 1m, 2m, and 3m markers from the start of the ramp.
3. Take a practice run with your ball. Roll it from the top of the ramp and begin timing it at the 0m mark.

You will need to take enough trial runs to get timing measurements for the following distances: 0m to 1m, 0m to 2m, and 0m to 3m

EVERYONE IN YOUR GROUP MUST CALCULATE THE DATA TO ENSURE ACCURATE RESULTS!

4. Record your time data below

   a. 0m to 1m _____sec., _____ sec., _____sec. = **Avg. Time _____ sec.**

   b. 0m to 2m _____ sec., _____ sec., _____sec. = **Avg. Time _____ sec.**

   c. 0m to 3m _____sec., _____ sec., _____sec. = **Avg. Time _____ sec.**

Data:

5. Calculate the instantaneous **velocity** at the following distances:

   d. 1m _____ (Hint: 1÷a)

   e. 2m _____ (Hint: 2÷b)

   f. 3m _____ (Hint: 3÷c)

6. Calculate the **time** between each of the following distances:

   g. 1m to 2m _____ (b – a)

   h. 2m to 3m _____ (c- b)

7. Calculate the **acceleration** for the following distances:

   i. 0m to 1m_____(d – 0 ÷ a)

   j. 1m to 2m_____(e – d ÷ g)

   k. 2m to 3m _____(f – e ÷ h)

Using your data from i-k, explain what is taking place:_____

8. In the space below, create a line graph that depicts the instantaneous speed (d-f). Label your X axis "distance" and your Y axis "velocity."

Conclusion:

1. Did your ball travel at a constant speed? How do you know?

2. What happened to the acceleration of the ball as it reached each distance (1m, 2m & 3m)? Did it accelerate or decelerate? Did this data prove or disprove your hypothesis?

3. How could you change the experiment to make the ball decelerate faster?

4. Human error must be accounted for when conducting a lab investigation. You should have noticed that the speed of the ball decreases as it travels. This is mainly due to the frictional force that exists between the ball and the floor. Therefore, you should have seen a decrease in the acceleration (deceleration) of the ball. If you did not see these results, what experimental error could have made your results inaccurate?